A one-year prospective investigation of Type D personality and self-reported physical health

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Abstract

Objective: Type D personality is characterised by negative affectivity and social inhibition, and is often associated with poorer physical and psychological health. However, the underlying mechanisms are unclear and the literature lacks longitudinal assessment. We aimed to prospectively examine the relationships between Type D and physical symptoms, in addition to retrospective health.

Design: An online questionnaire-based study (*N*=535) with a one-year follow-up (*N*=160) was conducted with healthy individuals (18-65years). Type D was assessed as a categorical and dimensional construct.

Main Outcome Measures: Participants completed Type D scale-14, Hospital Anxiety and Depression Scale, Cohen-Hoberman Inventory of Physical Symptoms and Perceived Stress Scale at both phases. Retrospective health questions and Social Readjustment Rating Scale were completed at follow-up.

Results: Type D was related to cardiac/sympathetic, metabolic, vasovagal, muscular, and headache symptoms at baseline. At follow-up stressful events and anxiety mediated the relationships between Type D and particular symptoms. Type Ds were more likely to report poorer health, and increased minor illnesses, work absences, and medical-information-seeking.

Conclusions: Type D is associated with stress-related symptoms. Although the relationships are primarily driven by NA, this supports the theory of a stress-related mechanism. These findings contribute to the literature highlighting Type D as a risk factor for poor health.

Introduction

Type D personality is characterised by the interaction of negative affectivity (NA) and social inhibition (SI) (Denollet, 2000). Type D individuals have the tendency to experience negative emotions including dysphoria, anger, anxiety, hostility, and general distress across situations and time, whilst also inhibiting the expression of these emotions in social situations due to fear of rejection or disapproval (Denollet, 1998b; Mols & Denollet, 2010a).

Since its initial proposal the prognostic validity of the Type D construct has been demonstrated in cardiac patient populations. However, there is accumulating evidence that Type D may be an important risk factor for poor health in other illness groups (Mols & Denollet, 2010a), as well as in otherwise 'healthy' individuals (Smith et al., 2018; Williams & Wingate, 2012), that is, individuals who are free from any chronic conditions. Existing research has established Type D as a predictor of poorer physical health, including increased somatic symptoms, general health complaints and immune related illnesses (Condén, Leppert, Ekselius, & Åslund, 2013; Stevenson & Williams, 2014; Williams & Wingate, 2012). Early estimates suggest that Type D personality was prevalent in 20% of the general population (Denollet, 2005). However, recent studies have estimated prevalence of up to 42.8% (Booth & Williams, 2015), which further exemplifies the importance of researching the health effects of Type D in 'healthy' populations

Type D has also been associated with increases in anxiety, depression, somatisation (Michal, Wiltink, Grande, Beutel, & Brähler, 2011), maladaptive stress reactivity (Habra, Linden, Anderson, & Weinberg, 2003; Howard & Hughes, 2013; Kelly-Hughes, Wetherell, & Smith, 2014; O'Leary, Howard, Hughes, & James, 2013), dysfunctional coping strategies, lower social support (Williams & Wingate, 2012), and adverse health behaviours (Booth & Williams, 2015) in the general population. Accordingly, these are all factors which may potentially mediate the relationship between Type D and physical health (Howard, Hughes, & James, 2011; Williams & Wingate, 2012). The relationship between Type D and health in the general population is beginning to receive more attention, and in a recent study, has been found to be mediated by anxiety and perceived stress (Smith et al., 2018). However, prospective

examination is required to further understand the mechanisms underpinning the now well-documented relationship.

Type D personality is traditionally assessed categorically, with individuals scoring above a particular threshold on both SI and NA being classified as Type D (Denollet, 2005). Although this approach is useful, it has also been criticised for not accurately representing the interactive effect of SI and NA, and typologies generated from two continuous variables in this way, have been criticised (Coyne et al., 2011). Consequently, Ferguson et al., (2009) has recommended that Type D may be better conceptualised as a dimensional variable. Therefore, in line with previous studies (e.g. Stevenson & Williams, 2014), Type D will be considered as both a categorical and a continuous variable within the current study.

Given previous findings linking Type D to a range of health outcomes including; poor prognosis in heart disease patients (Kupper & Denollet, 2007); cancer survivors (Mols, Denollet, Kaptein, Reemst, & Thong, 2012) and other clinical populations (Mols & Denollet, 2010a) as well as increased physical symptoms (Smith et al., 2018; Williams & Wingate, 2012), it appears necessary to assess the extent to which Type D personality may predict physical health over time. Moreover, there is a notable lack of longitudinal evidence to support the predictive value of Type D personality on health in the general population. This makes it difficult to reliably infer cause and effect, and limits the capacity to investigate potential mediating mechanisms (Maxwell & Cole, 2007). Therefore, a longitudinal assessment of the associations between Type D personality and physical symptoms, in addition to aspects of general health status and healthcare utilization, is warranted.

In light of the accumulating evidence with respect to the role of stress and distress in the Type D-health relationship (e.g. Smith et al., 2018) this study will examine the potential mediating effects of stress, anxiety and depression. The current study aims to contribute to our understanding of the pathways underpinning the relationship between Type D personality and the manifestation of physical symptoms. In light of the current Type D literature it is hypothesised that:

i) Type D personality will be linked to increased reporting of physical symptoms

ii) Stress, anxiety and depression will play a mediating role in the relationships between Type D and physical symptoms

iii) Type D personality will be related to poorer retrospective health outcomes, and decreases in healthcare utilisation due to their social inhibition

Method

Participants and Procedure

An online questionnaire based study was conducted with 535 healthy individuals (18-65 years). Participants were recruited online via social media platforms, student participation pools and via email within the researcher's institution. Of the baseline sample (*N* = 535), 293 participants consented to being contacted for the follow-up, and were sent an email invitation to the follow-up one year later (within one week of the date they completed baseline). At follow up, 160 participants took part within 30 days of email invitation receipt (*M*=5.45 days). The majority of participants were from the UK (90.09%), however due to the online nature of the study participants resided worldwide (non-UK Europe [2.43%]; North and South America [3.93%], Australia [1.50%] and Asia [1.68%]).

Exclusion criteria stipulated that individuals with a history of psychological health issues, known chronic or immune related illnesses, and diagnosed sleep disorders should refrain from taking part (including those diagnosed in the year between baseline and follow up). Course credit was given to those participants who were students at baseline, but no remuneration was offered at follow up. Information regarding reasons for non-participation was not collected.

Full study information was presented to participants via the Qualtrics platform at the beginning of each study phase and was accessed via the URLs provided. Informed consent was gained online via a multiple-choice selection and an option to provide an email address (to be contacted for the follow-up) was given at baseline. At each study phase participants provided date of birth and gender to ensure accurate matching of data. At baseline participants completed online versions of the DS14, CHIPS, PSS and HADS. At follow-up participants completed the DS14, CHIPS, PSS, and HADS a second time, in

addition to the SRRS and retrospective health questions (see Appendix 1). An online debrief was presented to participants at the end of each session. The study and its protocol were approved by the relevant institutional ethics committee prior to data collection.

Analyses revealed that individuals who took part in the follow up (M_{age} = 34.05, *SD*= 13.71) were significantly older than those who did not (M_{age}=28.00, *SD*= 12.13), *t* (533) = -5.073, p<.001. Chi squared analyses indicated no significant association i) between gender and follow-up status X^2 (1) =.865, *p*= .35, or ii) between Type D and follow-up status X^2 (1) =.034, *p*= .85. Participants' demographic and Type D data for each study phase are displayed in table 1.

TABLE 1 HERE

Materials

Type D scale- 14

Type D personality was assessed using the Type D Scale-14 (DS-14) (Denollet, 2005). The DS14 is a brief psychometrically sound measure of NA and SI, the combination of which is described as Type D personality. The instrument comprises a 7-item subscale measuring NA (e.g. 'I often feel unhappy') and a 7-item subscale measuring social inhibition (e.g. 'I often feel inhibited in social situations'). In initial validation studies (Denollet, 2005) both the NA and SI scales were found to be internally consistent (α= 0.88 and α= 0.86), and stable over a 3-month period (*r*=0.72 and *r*=0.82).

In line with traditional categorical assessment of Type D individuals scoring 10 or above on scales were classified as Type D. In order to analyse Type D as a dimensional construct a continuous measure was computed using the arithmetic product of SI and NA scores (SI*NA). Both methods were used in analyses as recommended by Stevenson & Williams (2014).

Cohen-Hoberman Inventory of Physical Symptoms

The Cohen-Hoberman Inventory of Physical Symptoms (CHIPS; Cohen & Hoberman, 1983) was used as the main outcome measure. The CHIPS is a list of 33 common physical symptoms (e.g. 'back pain'; 'diarrhoea') rated on a 5-point Likert scale ranging from (0) 'not been bothered by the problem'

to (4) ‘extremely bothered by the problem’ (during the previous 2 weeks). The total score is the sum of the responses on the 33 items (possible score range 0-132). Cronbach’s alpha for the overall CHIPS scale was .92, indicating good internal consistency.

The factor structure of the CHIPS has recently been examined (Allen, Wetherell, & Smith, 2017) and 8 ‘symptom clusters’ were identified as follows: ‘sympathetic/cardiac’ (7 items); muscular pain (6 items); ‘metabolic symptoms’ (5 items); ‘gastrointestinal’ (5 items); ‘vasovagal symptoms’ (4 items); ‘cold/flu’ (2 items); ‘headache’ (2 items); and ‘minor haemorrhagic symptoms’ (2 items). Each cluster was considered individually within the current study, with the exception of haemorrhagic symptoms, given the low internal consistency of this factor (Allen et al., 2017).

Perceived Stress Scale

Subjective stress was measured using the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). The PSS is a 10-item scale (α= 0.85) that assesses how respondents have experienced and dealt with stressful situations in the past month. Response choices are on a 5-point Likert scale and range from (0) “never” to (4) “very often” and a number of items are reverse scored. Scores are calculated by summing the 10 item ratings, and range from 0 to 40, with higher scores indicating higher levels of perceived stress.

Hospital Anxiety and Depression Scale

Levels of anxiety and depression were examined using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS comprises 14 items with answers coded between 0 and 3 (positively worded items are reversed scored). 7 items measure anxiety (α= 0.83) and 7 items measure depression (α=0.82), a separate score is derived for each scale with higher scores indicating higher levels of anxiety and depression, respectively.

Social Readjustment Rating Scale

The Social Readjustment Rating Scale (SRRS; Holmes & Rahe, 1967) assessed the number of stressful life events experienced over the past year. The scale comprises 42 items weighted by impact

(e.g. 100 points for death of a spouse, 11 points for minor violations of the law). The sum of the weighted items is calculated to give a total score for each participant.

Retrospective Health Questions

A number of retrospective health questions (see Appendix 1) were included in the follow-up. These comprised of 11 questions with 5- point multiple-choice responses. Questions covered perceptions of general health (e.g. how do you rate your current general health); frequencies of illness (how often have you suffered a non-serious illness?); use of healthcare services (how often have you visited your GP or other healthcare professional?); and seeking of medical advice (how often have you sought advice about health problem?). Example responses were categorical including scales of frequency (e.g. 'never' to 'often') and perceptions of quality (e.g. 'very good' to 'very poor').

Treatment of data

At baseline, all 535 participants completed the DS14, CHIPS and HADS; however, 11 participants did not complete the PSS. Therefore, for perceived stress at baseline only 524 cases were included in analyses. At follow up, all 160 participants completed all scales. Outliers greater than 3SDs above or below the mean were removed from the data (Osborne & Overbay, 2004) to ensure no extreme cases skewed the results. This resulted in minimal loss of data (1 Type D score [SI*NA] at baseline and 2 at follow-up). The remainder of the participants' data was included in analyses.

A power analysis was calculated using G*power 3.1. This indicated a sample size of n=125 would result in adequate power (0.803) for a small effect (f^2= 0.10) and n=85 for a medium effect (f^2=0.15).

Primary analyses comprised of independent samples t-tests to examine differences between Type D and non-Type D individuals on physical symptoms, anxiety, depression, and perceived stress. Pearson's correlations between the continuous Type D construct at baseline and the physical symptoms and psychological variables were also undertaken. Hierarchical multiple regression analyses controlling for the separate influences of SI and NA in step 1 were also conducted to determine whether Type D (SI x NA) at baseline had a significantly greater predictive value than that of NA and SI considered separately on physical symptoms at baseline.

Mediation analyses using the PROCESS macro for SPSS (Hayes & Preacher, 2013) were then used to examine if perceived stress, anxiety, depression, or stressful life events mediated the relationship between Type D and physical symptoms at follow up. Each mediator and outcome variable was entered into a separate model for analysis, and in line with recommendations for longitudinal research (Fitzmaurice, Laird, & Ware, 2012), baseline symptoms were entered as covariates into each model. This analysis was performed using the recommended 5,000 bootstrap resamples. In order to assess whether the potential mediators fully mediated the relationship between Type D and physical symptoms, the following conditions were required: i) the bootstrapped confidence intervals relating to the indirect effect must not overlap with 0, and ii) the direct effect when the mediator was included (Figure 1, path *c*') needed to become non-significant. In the case that only the first condition was met, then it could be concluded that partial mediation had occurred. The direct effect shows the direct relationship between Type D personality and CHIPS scores via path *c'* when each mediator is included in the model. The indirect effect shows the indirect relationship between Type D personality and CHIPS scores via each mediator (i.e. path *a***b*). The bootstrap mediation analyses performed are represented in Figure 1.

FIGURE 1 HERE

Results

Temporal stability

Paired samples t-tests indicated no significant differences between scores at baseline with scores at follow up on the measures of negative affect; *t(159)*=-0.333), *p*=.74, *d*=.053, social inhibition; *t(159)*=1.032 , *p*=.30, *d*=.175, or Type D (SI × NA); *t(157)*= 0.916 , *p*=.36, *d*=.145. Pearson's correlations analyses demonstrated strong correlations between baseline and follow-up scores; (SI; *r*= .857**, NA; *r*=.837**, Type D; *r*=.828**) indicating the DS14 exhibited excellent test-retest reliability, and stability over the year period. Consequently, for the purpose of the current study Type D scores and categorisation determined at baseline were used for the remaining analyses.

Test-retest correlations of SI, NA, Type D, anxiety, depression, perceived stress and total physical symptoms between baseline and follow up can be observed in table 2.

TABLE 2 HERE

Anxiety, depression and stress

As shown in Table 3, Type D participants reported significantly greater levels of anxiety, depression, and perceived stress at baseline (*N*=535) compared with non-Type D participants. These findings were supported by Pearson's correlational analyses, which indicated significant positive correlations between SI, NA, and total Type D (NA × SI) scores with anxiety, depression, and perceived stress at baseline.

TABLE 3 HERE

Physical symptoms

Type D participants reported significantly more physical symptoms than non-Type D participants at baseline across all symptom clusters. Pearson's correlational analyses indicated significant positive correlations between SI scores (at baseline) and physical symptoms, with the exception of gastrointestinal symptoms. NA scores and total Type D score (NA × SI) demonstrated significant positive correlations with all symptoms (see Table 3).

Multiple regression analyses (see Table S1) showed NA was a significant predictor of total symptoms at Step 1, with the overall regression model predicting a significant 20% of the variance in physical symptoms; $F(2, 522) = 65.35$, $p < .001$, $\eta p^2 = .200$. The overall regression model was also significant at Step 2; $F(3, 522) = 47.03$, $p < .001$, $\eta p^2 = .212$ and the Type D interaction term significantly predicted an additional 1.3% variance.

With respect to sympathetic/cardiac symptoms, NA was the only significant predictor at Step 1, accounting for 7.8% of the variance within a significant regression model; $F(2, 522) = 22.112$, $p < .001$, $\eta p^2 = .078$. The model was also significant at Step 2; $F(3, 521) = 16.834$, $p < .001$, $\eta p^2 = .082$, and Type D significantly predicted an additional 1.0% of the variance. NA was also a significant predictor of muscular symptoms at Step 1 within a significant model $F(2, 522) = 25.63$, $p < .001$, $\eta p^2 = .073$, explaining 8.9% of

the variance. Type D accounted for an additional 0.6% of the variance, but this was not significant. NA was again the only significant predictor in the model for vasovagal symptoms; $F(2, 522) = 31.67$, $p < .001$, $\eta p^2 = .108$, explaining 10.9% of the variance. At step 2, the model remained significant; $F(3, 521) = 24.21$, $p < .001$, $\eta p^2 = .122$, and Type D significantly predicted an additional 1.4% of the variance. Similarly, for headaches, 11.1% of the variance was accounted for in step 1, with NA the only significant predictor in the model; $F(2, 522) = 32.47$, $p < .001$, $\eta p^2 = .111$. At step 2 the model remained significant; $F(3, 521) = 25.72$, $p < .001$, $\eta p^2 = .123$, and Type D explained an additional 1.4% of the variance. NA was also a significant predictor of cold/flu symptoms at Step 1 within a significant model, $F(2,522) = 12.64$, $p < .001$, $\eta p^2 = .046$, and explained 4.6% of the variance. The model was also significant at Step 2; $F(3, 521) = 8.65$, $p < .001$, $\eta p^2 = .047$, however, Type D did not significantly predict any additional variance.

Mediating pathways

All symptom clusters at baseline significantly predicted the respective cluster at follow up (all p values ≤ .001). Type D was significantly related to the four mediating variables (path a); anxiety, depression, perceived stress (all p values ≤ .001), and stressful life events (p=.040). As shown in table 4, Type D personality was found to be a significant predictor of metabolic, cold/flu, and gastrointestinal symptoms (path c) one year later when baseline scores were controlled (total effect).

TABLE 4 HERE

Table 5 shows mediation analyses for the relationships between baseline Type D personality and metabolic; gastrointestinal; and cold/flu symptoms at follow up, via each of the mediating variables.

TABLE 5 HERE

The indirect effect (a*b) of Type D on metabolic symptoms (whereby the bootstrapped confidence interval for the indirect effect did not include 0) via both anxiety (*BaC CI* [.0017, .0070]) and stressful life events (*BaC CI* [.0001, .0020]) was significant. The direct effect (path *c'*) became non-significant when considered through the anxiety pathway (p=.130) indicating full mediation, and remained significant through the stressful life events pathway (p=.015) indicating partial mediation.

With respect to gastrointestinal symptoms, the indirect effect (a*b) of baseline Type D via stressful life events (*BaC CI* [.0001,.0014]) was significant, and stressful life events were found to partially mediated this relationship (the direct effect remained significant; *p*=.006). No mediating effects of, depression, anxiety and perceived stress were observed. Finally, no mediating effects of any of the variables were observed in the relationship between Type D and cold/flu symptoms

Retrospective Health

Perceived general health

Type D category was significantly related to i) perceptions of current general health (X^2 (4) =13.765, *p*=.004.), ii) perceptions of health over the past 12 months (X^2 (4) =11.637, *p*=.012) and iii) satisfaction with current health status (X^2 (4) =9.321, *p*=.046). Type Ds were more likely to rate their current general health as 'fair', their health over the past year as 'not very good', and be dissatisfied' with their current health status. Type Ds were also less likely to provide ratings of 'very good' for these questions. However, there were no differences in how participants compared their current health status to one year earlier (X^2 (4) =7.299, *p*=.099).

Frequency of illnesses

Type D also showed significant interactions with the frequency of i) feeling unwell or run-down (X^2 (4) =9.716, *p*=.035), ii) suffering a non-serious illness (not requiring a prescription) (X^2 (4) =12.015, *p*=.013) and iii) illness-related work absences (X^2 (4) =17.838, *p*<.001). Type Ds were more likely to have felt unwell or run-down 'frequently' and were less likely to have 'never' suffered a non-serious illness or taken time off work. However, Type D category did not relate to the frequency of participants suffering an illness requiring prescription medication; X^2 (4) =2.749, *p*=.65.

Healthcare utilisation

Type D was significantly associated with seeking medical information (without visiting a medical professional) (X^2 (4) =15.444, *p*=.003). Type D individuals were more likely to have 'never', or 'once or twice' sought medical information. Type D was not related to either frequency of GP (X^2 (4) =2.781,

p=.64) or hospital (X^2 (3) =3.213, *p*=.38) visits. (See Table S2 for responses to each retrospective health question for Type D and non-Type Ds)

Discussion

The current study is the largest to date to i) consider the relationship between Type D and physical symptoms in the general population, and ii) investigate differences in aspects of retrospective health and healthcare utilization in relation to Type D status. Analyses were conducted using both the categorical and dimensional approach to the construct, where possible, as recommended by Ferguson et al. (2009). A major strength of the study may be attributed to the longitudinal design, which is particularly beneficial in the consideration of the mediating factors. Furthermore, examination of the relationships with separate symptom clusters builds on previous work which has considered the relationship between Type D personality and a global measure of physical symptoms (Smith et al., 2018; Stevenson & Williams, 2014; Williams & Wingate, 2012), and extends our knowledge of the specific symptoms associated with Type D. The main findings indicate significant associations between Type D personality and particular stress-related symptoms (sympathetic/cardiac, muscular, metabolic, vasovagal, and headache). However, these symptoms were also found to be related to levels of NA but not SI in isolation. Relatively small relationships between Type D (interaction between SI and NA) and an increase in symptoms over the follow-up period were observed. It could therefore be speculated that the relationships observed may be predominantly attributed to the effect of negative affect on subjective health. This is discussed further with regards to the utility of the Type D construct.

The prevalence of Type D personality in the current study (45.6% at baseline and 45.0% at follow up) is higher than the prevalence rate typically reported in studies in the general population (Mols & Denollet, 2010b); however, it is comparable to a number of recent studies undertaken in the UK/Ireland (Booth & Williams, 2015; Williams et al., 2008), and Australia (Horwood, Chamravi, & Tooley, 2015). This may demonstrate an increase in Type D caseness over time (i.e. due to the pressure of modern society) or, speculatively, could be attributed to cultural differences. Further, Type D personality, and

its components showed significant stability over the year period, similar to other personality traits such as the 'big five' (Cobb-Clark & Schurer, 2012).

With respect to physical symptoms, categorical analyses indicated that Type Ds reported significantly greater frequencies of all symptom clusters in comparison to non-Type Ds. Correlational analyses also reflected this, demonstrating positive (albeit weak to moderate) relationships between Type D scores and the symptom clusters. These findings support previous studies conducted in both the general population (Stevenson & Williams, 2014; Williams & Wingate, 2012) and patient populations (e.g. Chapman, Duberstein, & Lyness, 2007). This also indicates that the relationships between Type D and physical symptoms exist across both the dichotomous and dimensional conceptualisations of Type D. However, in the regression models controlling for SI and NA, Type D was only found to be predictive of total symptoms, sympathetic/cardiac, muscular, metabolic, vasovagal, and headache symptoms. Stevenson and Williams (Stevenson & Williams, 2014) reported that the synergistic effect of Type D personality did not significantly predict physical symptoms when analysed in this way, although with a somewhat smaller sample. Our findings with a larger sample indicate that dimensional Type D can predict physical symptoms, possibly suggesting the previous study (Stevenson & Williams, 2014) could have been underpowered. However, owing to the fact that in the regression models SI did not predict any of the outcome variables under investigation here, it is acknowledged that these results demonstrate that levels of NA are largely responsible for the relationship. Further, the small Type D interaction effects observed here could alternatively be attributed to the possibility of a non-linear relationship between NA and symptoms, particularly as physical symptoms tend to be positively-skewed. This should also be considered when interpreting these findings, particularly with respect to the predictive utility of the Type D construct.

A significant relationship was observed between Type D and sympathetic/cardiac symptoms, however again the contribution of social inhibition was minimal. Nevertheless, this finding corresponds with the abundance of literature linking Type D personality to adverse cardiovascular outcomes (Borkoles, Polman, Ski, & Thompson, 2012; Denollet, 1998a; Howard & Hughes, 2013; Kelly-Hughes et

al., 2014; Kupper & Denollet, 2007; Nyklíček, Vorselaars, & Denollet, 2011; Pedersen & Denollet, 2003; Sher, 2005). Given this was demonstrated in a healthy population, this may indicate that the influence of Type D in cardiac-related health begins to manifest prior to disease onset, supporting existing evidence of Type D personality as an independent cardiovascular risk marker (Hausteiner, Klupsch, Emeny, Baumert, & Ladwig, 2010). On the other hand, this could simply indicate that high levels of negative affect could be particularly detrimental to cardiac health. Either way, this supports previous research in which various psychosocial factors have been implicated in the aetiology and pathogenesis of cardiovascular disease (CVD) and poor cardiac health (Black & Garbutt, 2002), most notably; acute and chronic stress (Lagraauw, Kuiper, & Bot, 2015). Considering the previous links between Type D and CVD, in addition to the current finding with regards to cardiac symptoms, it could be postulated that stress may play a mediating role in the relationship.

Further, as stress is associated with various health outcomes, it is likely this theory could explain the observed associations with other symptom clusters. For example, the observed relationship between Type D and Vasovagal symptoms (e.g. 'dizziness') may represent issues with vitality and exhaustion. Lack of vitality and exhaustion are issues associated with both acute (Kudielka et al., 2006) and chronic (Bellingrath, Weigl, & Kudielka, 2009) stress and are theorised to be underpinned by autonomic dysfunction (Hall, Podawiltz, & Mummert, 2012), a problem linked to the body's inability to cope with demands. Furthermore, headaches; which are often attributed to heightened stress levels (Björling, 2009), were also found to be predicted by the continuous Type D measure in the current study. The relationship observed between Type D and muscular pain supports similar, albeit solely categorical, findings of Condèn and colleagues (2013) who observed increased musculoskeletal problems in Type D adolescents.

With respect to the stress-related theory; the items on the metabolic symptom factor including weight change, poor appetite, and sleep problems, are also associated with prolonged experiences of stress (Kim & Dimsdale, 2007; Serlachius, Hamer, & Wardle, 2007) and are common symptoms of burnout (Lundgren-Nilsson, Jonsdottir, Pallant, & Ahlborg, 2012). Existing research has demonstrated

links between Type D personality and symptoms of burnout and related mental health issues (Geuens, Braspenning, Van Bogaert, & Franck, 2015; Ogińska-Bulik, 2006; Polman, Borkoles, & Nicholls, 2010), and exemplifies the potential importance of distress in the Type- D health relationship.

The mediation analyses revealed that Type D scores at baseline significantly predicted metabolic symptoms, gastrointestinal, and cold/flu symptoms at follow up, when baseline measures were controlled for (in line with recommendations for longitudinal analyses). This suggests that Type D personality may lead to a deterioration in health via these symptom clusters over time. However, the large contribution of NA to these relationships should be highlighted. With respect to the observed relationship with gastrointestinal symptoms, previous studies have also found links between Type D and poorer outcomes (i.e. increased symptom severity and lower quality of life) in patients with functional gastrointestinal disorders (Hansel et al., 2010), and irritable bowel syndrome (Sararoudi et al., 2011). As for cold and flu like symptoms, it is well established that these types of symptoms often manifest in viral respiratory infections as a consequence of a dampened immune system (Kelly & Busse, 2008). Lowered immune response has been found to be exacerbated by increased stress and maladaptive stress response via increases in cortisol (Kiecolt-Glaser et al., 1987; Smolderen, Vingerhoets, Croon, & Denollet, 2007) which may further indicate the possibility of a stress-related mechanism underpinning the Type D-health relationship. Cold and flu symptoms are however, also associated with inflammatory allergies such as hay fever and asthma (Ciprandi et al., 2005). Therefore, it could be suggested that the effects of Type D personality may extend to abnormalities with inflammatory processes. This notion has previously been evidenced in cardiac populations (Denollet et al., 2009), however, further research in non-cardiac populations, as well as healthy individuals is required.

Unsurprisingly, Type D individuals reported significantly greater levels of perceived stress than their non-type D counterparts, which replicates similar studies examining perceived stress in Type D individuals (Habra et al., 2003; Kelly-Hughes et al., 2014; Ogińska-Bulik, 2006; Polman et al., 2010). However, analyses indicated that baseline measures of perceived stress did not significantly predict metabolic, gastrointestinal or cold/flu symptoms. Stressful life events, on the other hand, were related

to these symptoms, and mediation analyses indicated partial mediation via stressful life events between Type D and metabolic and gastrointestinal symptoms. These findings indicate that Type D personality is associated with an increased likelihood of experiencing stressful life events, which in turn enhances the likelihood of experiencing these symptoms. It could be suggested that Type D individuals may be more likely to experience or classify an event as stressful due to their propensity to negative emotions. The link between stressful life events and these symptoms supports research demonstrating associations between increased stress and metabolic problems (e.g. poor appetite, sleep problems and fatigue; Kim & Dimsdale, 2007; Serlachius et al., 2007) and gastrointestinal illnesses such as IBS (Pract, 2016) further exemplifying the role of stress in the relationship between Type D personality and poor health outcomes.

These findings are not entirely surprising, given the large body of literature linking NA (and neuroticism) to both distress and negative health outcomes (e.g. Watson & Pennebaker, 1989, Cohen et al., 1995). Further, this leads to speculation regarding the fully interactive effect of Type D, and the influence of social inhibition on health related outcomes. While correlations were observed between SI and the majority of outcomes in the current study, SI was not a significant predictor of any symptoms in the first step of the regression analyses. A potential explanation for these seemingly contradictory findings is conceptual overlap between NA and SI, particularly given the high correlation between these variables at both time points.

Type D personality was also found to be associated with higher levels of anxiety in the current study, and anxiety fully mediated the relationship between Type D personality and metabolic symptoms. This supports previous findings which have demonstrated links between anxiety and increased somatic symptoms (Haug, Mykletun, & Dahl, 2004) and Type D personality (e.g. Pedersen, van Domburg, Theuns, Jordaens, & Erdman, 2004) and seems logical given that metabolic symptoms (e.g. feeling low in energy, poor appetite) are related to stress and burnout, which in turn are linked to Type D personality (Ogińska-Bulik, 2006).

Levels of depression were also associated with Type D, however they were not found to mediate any of the relationships between Type D and the symptom clusters in the current study. As the prevalence of depression is well-documented in the Type D and cardiovascular disease literature (Barth, Schumacher, & Herrmann-Lingen, 2004; De Voogd et al., 2009; Grande, Romppel, & Barth, 2012) it was assumed that depression may be involved in the relationship between Type D and general ill health. However, given these findings in healthy individuals, it could be suggested that depression may emerge in Type D individuals as a risk factor for poorer health outcomes in the later stages of illness.

With further regards to these mediation analyses, it must be acknowledged that negative affect, stress, depression, and anxiety are not entirely distinct constructs, but are in fact very closely related measures of psychological morbidity (e.g. Clara, Cox, & Enns, 2001; Haug, Mykletun, & Dahl, 2004). Given the overlap between these constructs, it may be expected that the findings would be highly similar for each of the different mediators. However, this was not the case, as mediation by the psychological morbidity variables emerged for some of the physical symptoms but not others, and the mediation models revealed different mediation effects for each of the psychological morbidity variables. Of course, the issue remains that Type D and other measures of psychological morbidity are difficult to disentangle, and the outcomes of the mediation analyses should be interpreted in this context.

Finally, in terms of retrospectively reported health, categorical findings indicated that Type D participants were more likely to rate their health as poorer, and be more dissatisfied with their current health status. Those classified as Type D were also more likely to experience feeling unwell or run down, suffer non-serious illnesses and be absent from work due to sickness. These findings correspond with the findings of a meta-analysis (Mols & Denollet, 2010b) demonstrating links between Type D and both poorer health status and increased work-related issues (e.g. absenteeism). In the current study, Type D individuals were also less likely to have sought medical advice in the past year. Given their high levels of social inhibition, this may suggest a preference to seek out medical information from other sources; however, this requires further investigation. No differences were observed with regards to medication

use, GP visits, or hospital attendance between Type Ds and non-Type Ds. However, as Type Ds reported more minor illnesses, these findings in combination may further suggest that Type D individuals are less likely to seek treatment when they are unwell. On the other hand, it could also be proposed that Type D individuals have an increased sensitivity to sensations attributed to certain symptoms (Cohen et al., 1995), hence the increased reporting of illnesses. However, if the theory that they tend to avoid medical advice holds true, then it may be the case that Type Ds neglect to report those more serious illnesses which may require treatment. Again, this requires further investigation.

The current study has a number of strengths. The study had a reasonably large sample from the general population which was not limited to undergraduate students or the UK/Ireland population and therefore results are more generalizable in comparison to similar recent studies (e.g. Polman et al., 2010; Stevenson & Williams, 2014). Furthermore, the use of a dimensional conceptualisation of Type D in addition to the traditional categorical approach, offered a more rigorous approach to analysis in comparison to earlier studies (Stevenson & Williams, 2014). The use of multiple regression analyses allowed for the statistical control of the independent effects of NA and SI, which is particularly important given the well documented links between negative emotions and physical health, as discussed.

The longitudinal design is a further strength, which has enabled the advancement of knowledge regarding the links between Type D personality and health including a clearer picture of the directionality of the relationships identified (Farrington, 1991). The longitudinal design has also facilitated the investigation of changes in perceived health status and healthcare utilisation over a year period, in Type D individuals, which extends previous cross-sectional work (Chapman et al., 2007; Jellesma, 2008; Michal et al., 2011; Stevenson & Williams, 2014). This is a particular benefit as very few previous Type D studies in the general population have implemented a longitudinal design in the past.

The online data collection methodology was particularly useful for recruiting large numbers of participants at both baseline and the follow up, as completion could be executed entirely remotely. Nevertheless, the follow up did suffer a 70% attrition rate. Online data collection can increase perceptions of privacy, and encourage participants to disclose more information (Branley, Covey, &

Hardey, 2014). Therefore, given the social inhibitory nature of Type Ds (Denollet, 2005), online recruitment is particularly useful for recruiting individuals from this population. This could also explain the prevalence of Type D participants in the current study. Finally, this data collection method also enabled the monitoring of the timeframe in which participants completed the follow-up, which ensured relative consistency in the interval between the collection of baseline and follow-up data.

Nonetheless, there are a number of limitations associated with the use of online data collection methods, including confinement of participation to internet users only. Online studies also often attract larger proportions of females and younger participants (Lefever, Dal, & Matthíasdóttir, 2007) which is reflected in the large proportion of females and relatively low mean age of the sample in the current study. Although research suggests females are more likely to report somatic symptoms (Gijsbers Van Wijk & Kolk, 1997), the prevalence of Type D personality does not greatly differ between males and females, therefore limiting the issues of the gender imbalance (Mols et al., 2012).

However, in the current study a larger percentage (~8-10% more) of males were classified as Type D at both baseline and follow up. This does not reflect the general finding that females tend to report higher levels of negative affect (e.g. Watson & Pennebaker, 1989), and is also somewhat dissimilar to a sample of the general population from Germany in which a marginally higher percentage of females (31.6% compared to 30.6% of males) were classified as Type D (Grande et al., 2010). This could perhaps be due to a higher prevalence of social inhibition in males, particularly in the UK where the majority of the current participants resided. Alternatively, given their social inhibition, the anonymity of the current online method of data collection may have attracted more Type D males, due to the fact they could participate while avoiding social interaction.

Further limitations include the general issues that arise with the reliance on subjective measures, such as the risk of self-report biases and social desirability. However, self-report methodology still maintains substantial merit and is regarded as a reliable technique for assessing perceived health and physical symptoms (Cella et al., 2010) Further, with regards to the symptom perception hypothesis (Watson & Pennebaker,1989), it must also be considered that distress can influence perceptions of

health (Farmer & Ferraro, 1997; Tessler & Mechanic, 1978), and in turn self-reported health outcomes. Self-reported health impairments may therefore be exaggerated in Type D individuals, given their predisposition to negative emotions (Benham, 2006). This is an issue with most Type D health research utilising self-report measures, and must be considered in the interpretation of these findings.

Furthermore, although the inclusion of retrospective health questions was beneficial in complementing the assessment of physical symptoms in the current study, retrospective health information is considered less reliable relative to prospective or ambulatory self-report methods (Taffe & Dennerstein, 2000) and causality cannot be reliably inferred. Therefore, future research may wish to gauge long term health by requiring regular prospective or ambulatory health assessments over the full study period. Finally, the follow up period of one year was a reasonably short timeframe for investigating the development of poor health in generally healthy individuals. Therefore, it is suggested that implementation of a longer follow-up period in future studies may aid in extending our understanding of the development of physical symptoms in relation to Type D personality. Further, in light of the findings signifying the stress-related nature of symptoms that appear to be related to aspects of Type D personality, it is suggested that objective measures of stress and health (e.g. sympathetic activation, cortisol and levels of inflammation) should be explored in future studies, to aid in understanding the psychobiological mechanisms underpinning these relationships.

Finally, there is some debate as to whether the Type D construct can adequately explain health related variables over and above other personality factors (e.g. neuroticism from the 'big five'). Studies are still emerging in the literature which support a role for the NA x SI interaction as a predictor of numerous health outcomes (e.g. Howard & Hughes, 2011). However, it has also been suggested that NA and SI may be better represented by neuroticism and extraversion, given the superior psychometric evidence that exists to support the validity of these constructs (Howard & Hughes, 2011; Horwood & Anglim, 2017). Another thing to consider with regards to the association between aspects of personality and health variables is the influence of conscientiousness, given its emergence in the literature as an important predictor of health status (Bogg & Roberts, 2004).

In summary, the current study has provided evidence that Type D personality may predict particular symptoms which are often associated with heightened stress. These findings extend previous cross-sectional work in healthy individuals, and provide some prospective evidence that links between Type D and physical symptom clusters exist, although the precedence of NA as the primary contributing factor must be acknowledged. The predictive ability of Type D (NAxSI interaction) for stress-related symptoms has been shown to augment, albeit marginally, the influence of NA in isolation on aspects of subjective health. However, as mentioned above, the findings should be interpreted in the context of the various criticisms of the Type D construct, including suggestions that effects are primarily driven by NA. Anxiety and stressful life events were found to play mediating roles in the relationships with and both metabolic and gastrointestinal symptoms, which may exemplify the importance of stress and distress in the Type D-health relationship. Given the aforementioned overlap in general psychological morbidity between the constructs being investigated as mediating variables here, further work is warranted to elucidate the mechanisms underpinning the relationship between Type D personality and physical health outcomes. Finally, retrospective assessment of health status and healthcare utilisation indicated that individuals categorically defined as Type D report poorer health status, increased minor illness and work absences, but are less likely to seek medical information.

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TABLES

Table 1. Participant demographic and Type D data

	N	Age	Gender		Type D category		Continuous Type D scores		
		M (SD)	Males n(%)	Females n(%)	Type D n(%)	Non Type D n(%)	SI M(SD)	NA M(SD)	Type D M(SD)
Baseline	535	29.80 (12.90)	104 (19.4%) 51.9% Type D	431 (80.6%) 44.1% Type D	244 (45.6%)	291 (54.4%)	11.38(6.33)	12.33(6.33)	149.77(126.72)
Follow-up	160	34.05 (13.71)	33 (20.6%) 50.4% Type D	127 (79.4%) 41.7% Type D	72 (45.0%)	88 (55.0%)	11.69 (6.91)	12.38 (6.81)	157.84 (149.24)

Table 2. Correlations between baseline measures of Type D, anxiety, depression, perceived stress and total symptoms with measures at follow-up including mean scores [SD] (N=160).

		Follow up								Mean [SD]		
	Measures	SI	NA	Type D	Symptoms	Anxiety	Depression	Perceived Stress	Life events	Total	Males	Females
Baseline	SI	.857**	.400**	.713**	.283**	.306**	.405**	.400**	.021	11.69 [6.91]	13.39 [6.36]	11.25 [7.00]
	NA	.329**	.837**	.605**	.513**	.664**	.496**	.626**	.271**	12.38 [6.81]	12.73 [6.73]	12.29 [6.85]
	Type D	.652**	.673**	.809**	.502**	.555**	.509**	.611**	.180*	157.84 [149.24]	177.47 [151.54]	152.86 [148.85]
	Symptoms	.2418*	.562**	.427**	.750**	.678**	.419**	.505**	.407**	17.30 [15.58]	14.33 [13.85]	18.07 [15.96]
	Anxiety	.237**	.692**	.457**	.609**	.766**	.489**	.594**	.471**	8.49 [4.25]	8.12 [4.39]	8.52 [4.28]
	Depression	.395**	.566**	.526**	.374**	.501**	.703**	.543**	.326**	4.15 [3.44]	4.91 [3.69]	3.92 [3.36]
	Perceived Stress	.348**	.601**	.587**	.421**	.482**	.475**	.604**	.231**	17.31 [7.78]	15.58 [7.04]	17.36 [8.10]
Mean [SD]	Total (n=160)	11.40 [6.46]	12.48 [6.43]	148.88 [128.47]	17.90 [16.20]	7.60 [4.82]	3.96 [3.63]	16.86 [7.81]	192.85 [130.18]			
	Male (n= 33)	13.03 [6.05]	13.15 [5.99]	168.66 [124.64]	14.61 [12.72]	6.82 [3.67]	4.24 [3.58]	16.18 [6.88]	162.33 [110.15]			
	Females (n= 127)	10.98 [6.52]	12.31 [6.55]	143.82 [129.43]	18.76 [16.93]	7.74 [5.10]	3.86 [3.66]	16.90 [8.16]	196.22 [136.13]			

*p<0.05; **p<0.001

Table 3. Baseline analyses for the measures of anxiety, depression, perceived stress and physical symptom clusters; i) independent samples t-tests indicating differences between Type D groups (Mean [±SD]) and; ii) Pearson's correlations with continuous SI, NA and Type D scores (N= 535).

	Between groups						***Correlations***				
Measures	**Non-Type D**	**Type D**	***t***	***df***	***p***	***d***	**SI**	**NA**	**Type D**	***M***	***SD***
Anxiety	7.16 (3.54)	10.30 (3.74)	-9.930	532	<.001**	.861	.305**	.683**	.492**	8.59	3.95
Depression	2.92 (2.71)	5.57 (3.38)	-10.050	530	<.001**	.873	.385**	.547**	.502**	4.13	3.31
Perceived Stress	15.72 (6.41)	22.07 (6.36)	-11.331	522	<.001**	.981	.383**	.672**	.556**	18.55	7.06
Total symptoms	14.64(14.54)	21.84 (16.27)	-5.407	533	<.001**	.468	.186**	.448**	.369**	17.93	15.75
Cardiac/sympathetic	1.69 (3.83)	2.75 (4.02)	-3.126	533	.002*	.271	.117**	.290**	.235**	2.18	3.95
Muscular	2.34 (3.25)	3.71 (4.27)	-4.217	533	<.001**	.365	.156**	.292**	.273**	2.96	3.81
Metabolic	4.48 (4.09)	6.63 (4.51)	-5.763	533	<.001**	.500	.184**	.481**	.361**	5.46	4.41
Gastrointestinal	1.64 (2.99)	2.36 (2.92)	-2.782	533	.006*	.241	.065	.247**	.193**	1.97	2.98
Vasovagal	1.22 (2.42)	1.98 (2.82)	- 3.349	533	.001**	.290	.150**	.325**	.294**	1.57	2.63
Cold	1.78 (2.12)	2.16 (2.29)	-1.976	533	.049**	.171	.095*	.220**	.147**	1.96	2.20
Headache	1.18 (1.55)	1.94 (2.14)	-4.774	533	<.001	.414	.165**	.318**	.311**	1.52	1.88

*p<0.05; **p<0.001

Table 4. The relationship between Type D at baseline (path c) and each symptom cluster at follow up controlling for baseline symptoms (N=158).

	Total effect (path *c*)			
Factor	*β*	*SE*	*t*	*p*
Total Symptoms	.0138	.0079	1.744	.083
Cardiac	.0047	.0038	1.230	.22
Metabolic	.0047	.0019	2.430	.016*
Muscular pain	.0014	.0017	0.810	.42
Gastro	.0058	.0017	3.465	<.001**
Vasovagal	.0008	.0013	0.596	.55
Cold/Flu	.0025	.0009	2.690	.008*
Headaches	.0006	.0009	0.704	.48

***p*<.001, **p*<.05

Table 5. Mediation between Type D and metabolic, gastrointestinal and cold/flu symptoms by PSS, anxiety, depression and stressful life events (N=158)

		Relationship between mediator and symptom (path *b*)			**Direct effect (*c'*path)** [1]					**Indirect effect (a*b)** [2]			
Symptoms	Mediator	*β*	*SE*	*p*	*β*	*SE*	*p*	*LLCI*	*ULCI*	*β*	*SE*	*LLCI*	*ULCI*
Metabolic	Anxiety	.2662	.0837	.002	.0028	.0018	.13[a]	-.0008	.0064	.0041	.0013	.0017	.0070
	Depression	-.0503	.1120	.65	.0051	.0023	.027	.0006	.0097	-.0007	.0015	-.0037	.0023
	Perceived stress	.0428	.0466	.36	.0037	.0022	.091	-.0006	.0080	.0013	.0015	-.0011	.0048
	Life events	.0041	.0017	.017	.0046	.0019	.015[b]	.0009	.0082	.0006	.0004	.0001	.0020
Gastro-	Anxiety	.0604	.0720	.40	.0050	.0020	.013	.0011	.0090	.0009	.0010	-.0012	.0028
intestinal	Depression	.0666	.0796	.40	.0049	.0021	.019	.0008	.0090	.0009	.0011	-.0012	.0031
	Perceived stress	-.0170	.0437	.69	.0063	.0025	.012	.0014	.0112	-.0005	.0011	-.0025	.0015
	Life events	.0029	.0013	.034	.4068	.1454	.006[b]	.0021	.0087	.0004	.0003	.0000	.0014
Cold/flu	Anxiety	.0455	.0436	.29	.0018	.0012	.13	-.0005	.0042	.0007	.0006	-.0004	.0021
	Depression	-.0903	.0442	.043	.0037	.0011	.002	.0014	.0059	-.0012	.0006	-.0025	-.0001
	Perceived stress	.0454	.0267	.090	.0011	.0013	.40	-.0014	.0036	.0014	.0008	.0000	.0032
	Life events	.0016	.0011	.15	.0021	.0009	.019	.0003	.0039	.0003	.0002	.0000	.0010

[1] c' path is the relationship between Type D and the symptom when the mediator is included in the model. [a]Full mediation. [b]Partial mediation.

[2]The indirect (mediation) effect is significant if the bootstrapped confidence intervals do not include 0.

FIGURES

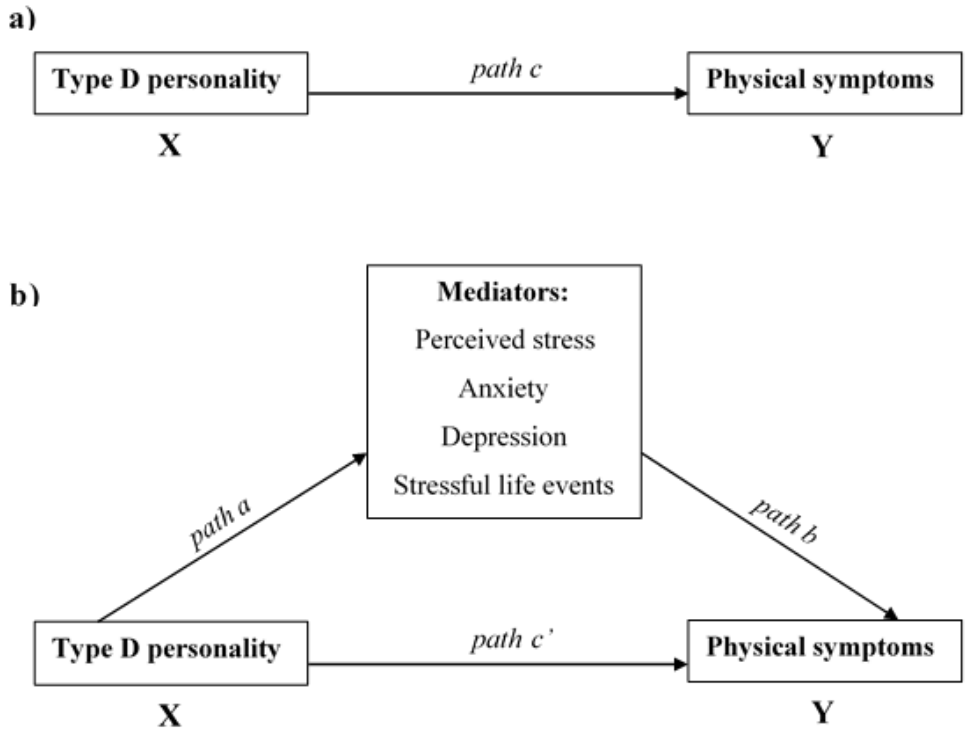

Figure 1. *Non-mediated (a) and mediated (b) pathways between Type D personality and physical symptoms (each symptom cluster was considered in a separate statistical model). Path c' represents the direct effect of Type D personality on physical symptoms with the mediator included in the model. The indirect effect is the product of path a and path b. Each mediator was considered in a separate statistical model. All models controlled for the baseline symptom score in model of Y only.*

APPENDIX

Appendix A - Retrospective Health Questions

1) How is your health in general right now, would you say it was:
- Very Good
- Good
- Fair
- Bad
- Very Bad

2) Over the last 12 months would you say your health has, on the whole, been ...:

- Very Good
- Good
- Fairly good
- Not very good
- Not good at all

3) Compared to one year ago, how would you say your health is now?

- Much better now than 1 year ago
- Somewhat better now
- About the same as 1 year ago
- Somewhat worse now
- Much worse now

4) How satisfied are you with your health in general?

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Dissatisfied
- Very dissatisfied

5) During the last year, approximately how often have you felt generally ill, unwell or run down (due to tiredness, fatigue, stress etc.)?

- Never
- Rarely
- Sometimes
- Frequently
- Always

6) During the last year, approximately how often have you suffered a non-serious illness such as a cold, stomach bug or minor infection which has not required prescription medication?

- Never
- Once or twice

- Three or four times
- Five or six times
- More than six times

7) During the last year, approximately how often have you suffered a more serious illness which has required prescription medication (e.g. antibiotics, steroidal medication)?

- Never
- Once or twice
- Three or four times
- Five or six times
- More than six times

8) During the last year, approximately how frequently have you had to take time off work due to illness?

- Never
- Once every 3-4 months
- Once every 2-3 months
- approximately once per month
- More than once per month
- Not applicable (if retired/un-employed/maternity leave etc)

9) During the last year, approximately how regularly have you visited your GP or other healthcare profession (e.g. district nurse, walk-in-centre) because of a health problem?

- Never
- Once every 3-4 months
- Once every 2-3 months
- Approximately once per month
- More than once per month

10) During the last year, approximately how regularly have you sought medical information about a problem with your health without visiting a medical professional (e.g. via telephone, post or email, health leaflets, online health information websites)?

- Never
- Once every 3-4 months
- Once every 2-3 months
- approximately once per month
- More than once per month

11) During the last year, have you ever been admitted to hospital?

- Never been in hospital
- Yes, On 1 occasion I have been in hospital for treatment as a day-patient
- Yes, On 1 occasion I have been in hospital as an inpatient and stayed overnight or longer
- Yes, On multiple occasions I have been in hospital for treatment as a day-patient
- Yes, On multiple occasions I have been in hospital as an inpatient and stayed overnight or longer

SUPPLEMENTARY MATERIAL

Table S1 – Table of hierarchical multiple regression analyses demonstrating the prediction of self-reported physical symptoms at baseline by SI, NA and Type D (N=535).

Symptom			*B*	*SE b*	*β*	*t*	*p*	R^2 (ΔR^2)
Total	Step 1	SI	-.066	.111	-.026	-.597	.55	
symptoms		NA	1.154	.109	.458	10.623	<.001	.200**
	Step 2	SI	-.631	.223	-.244	-.2832	.005	
		NA	.679	.195	.269	3.475	.001	
		Type D	.045	.015	.361	2.917	.004	.213 (.013**)
Sympathetic	Step 1	SI	-.016	.030	-.025	-.542	.59	
/Cardiac		NA	.181	.029	.289	6.248	<.001	.078**
	Step 2	SI	-.141	.059	-.220	-2.373	.018	
		NA	.075	.052	.121	1.447	.15	
		Type D	.010	.004	.323	2.422	.016	.088(.010*)
Muscular	Step 1	SI	.016	.028	.025	.554	.58	
		NA	.172	.028	.288	6.255	<.001	.089**
	Step 2	SI	-.094	.057	-.153	-1.661	.097	
		NA	.080	.050	.133	1.608	.11	
		Type D	.009	.004	.296	2.230	.026	.098 (.009*)
Metabolic	Step 1	SI	-.038	.031	-.053	-1.243	.22	
		NA	.346	.030	.491	11.543	<.001	.222**
	Step 2	SI	-.148	.062	-.205	-2.401	.017	
		NA	.254	.054	.359	4.681	<.001	
		Type D	.009	.004	.252	2.054	.041	.228 (.006*)
Gastro-	Step 1	SI	-.028	.023	-.057	-1.217	.22	
intestinal		NA	.133	.022	.277	5.959	<.001	.067**
	Step 2	SI	-.104	.046	-.212	-.2.262	.024	
		NA	.069	.040	.144	1.708	.088	
		Type D	.006	.003	.256	1.908	.057	.073 (.006)
Vasovagal	Step 1	SI	.002	.020	.004	.086	.93	
		NA	.139	.019	.328	7.206	<.001	.109
	Step 2	SI	-.097	.040	-.223	-2.446	.015	
		NA	.056	.035	.132	1.616	.11	

		Type D	.008	.003	.375	2.866	.004	.122(.014**)
Cold/Flu	Step 1	SI	-.006	.017	-.015	-.329	.74	
		NA	.078	.017	.221	4.696	<.001	.046**
	Step 2	SI	.019	.034	.053	.561	.58	
		NA	.099	.030	.280	3.287	.001	
		SI × NA	-.002	.002	-.114	-.834	.41	.047(.001)
Headache	Step 1	SI	.011	.014	.036	.797	.43	
		NA	.096	.014	.316	6.953	<.001	.111**
	Step 2	SI	-.059	.028	-.192	-2.105	.036	
		NA	.036	.025	.120	1.463	.14	
		Type D	.006	.002	.377	2.882	.004	.125(.014**)

*p<0.05; **p<0.01 B = unstandardized beta, $SE\ b$ = standard error of unstandardized beta, β = standardised beta, R^2 = R-squared, ΔR^2 = R-squared change.

Table S2 – Table showing number (%) of responses to each retrospective health question

Question	*Response*	**Non-Type D**	**Type D**	**Total**
Perception of current health	Very good	28 (17.7%)	9 (5.7%)	37 (23.4%)
	Good	42 (26.6%)	34(21.5%)	76 (48.1%)
	Fair	14 (8.89%)	24 (15.2%)	38 (24.1%)
	Bad	2 (1.3%)	4(2.5%)	6 (3.8%)
	Very Bad	0 (0.0%)	1 (0.6%)	1 (0.6%)
Perception of health over past year	Very good	32 (20.3%)	13 (8.2%)	45 (28.5%)
	Good	37 (23.4%)	33 (20.9%)	70 (44.3%)
	Fair	14 (8.9%)	19 (12.0%)	33 (20.9%)
	Not very good	2 (1.3%)	7 (4.4%)	9 (5.7%)
	Not good at all	1 (0.6%)	0 (0.0%)	1 (0.6%)
Change in health over past year	Much better	10 (6.4%)	2 (1.3%)	12 (7.6%)
	Somewhat better	14 (8.9%)	20 (12.7%)	34 (21.7%)
	About the same	44 (28.0%)	36 (22.9%)	80 (51.0%)
	Somewhat worse	16 (10.2%)	14 (8.9%)	30 (19.1%)
	Much worse	1 (0.6%)	0 (0.0%)	1.0 (0.6%)
Satisfaction with their current health status	Very Satisfied	20 (12.7%)	13 (8.2%)	33 (20.9%)
	Satisfied	44 (27.8%)	24 (15.2%)	68 (43.0%)
	Neither	8 (5.1%)	11 (7.0%)	19 (12.0%)
	Dissatisfied	13 (8.2%)	22 (13.9%)	35 (22.2%)
	Very Dissatisfied	1 (0.6%)	2 (1.3%)	3 (1.9%)
Frequency of feeling unwell or run-down	All the time	3 (1.9%)	3 (1.9%)	6 (3.8%)
	Frequently	14 (8.9%)	22 (13.9%)	36 (22.8%)
	Sometimes	35 (22.2%)	33 (20.9%)	68 (43.0%)
	Rarely	32 (20.3%)	14 (8.9%)	46 (29.1%)
	Never	2 (1.3%)	0 (0.0%)	2 (1.3%)
Frequency of suffering a non-serious illness	Seven or more times	1 (0.6%)	3 (1.9%)	4 (2.5%)
	Five or six times	8 (5.1%)	12 (7.6%)	20 (12.7%)
	Three or four times	21 (5.1%)	22 (13.9%)	43 (27.2%)
	Once or twice	43 (27.2%)	34 (21.5%)	77 (48.7%)
	Never	13 (8.2%)	1 (0.6%)	14 (8.9%)
	Seven or more times	1 (0.6%)	0 (0.0%)	1 (0.6%)

Frequency of illnesses requiring prescription medication	Five or six times	1 (0.6%)	3 (1.9%)	4 (2.5%)
	Three or four times	3 (1.9%)	3 (1.9%)	6 (3.8%)
	Once or twice	30 (19%)	28 (17.7%)	58 (36.7%)
	Never	51 (32.3%)	38 (24.1%)	89 (56.3%)
Frequency of work absences	Very frequently	0 (0.0%)	3 (1.9%)	3 (1.9%)
	Quite regularly	0 (0.0%)	1 (0.6%)	1 (0.6%)
	A few times	7 (4.5%)	12 (7.6%)	19 (12.1%)
	Once or twice	35 (22.3%)	27 (17.2%)	62 (39.5%)
	Never	42 (26.8%)	21 (13.4%)	63 (40.1%)
Frequency of GP visits	Very frequently	1 (0.6%)	1 (0.6%)	2 (1.3%)
	Quite regularly	2 (1.3%)	5 (3.2%)	7 (4.4%)
	A few times	20 (12.7%)	15 (9.5%)	35 (22.2%)
	Once or twice	42 (26.6%)	30 (19.0%)	72 (22.2%)
	Never	21 (13.3%)	21 (13.3%)	42 (26.6%)
Seeking medical information	Very frequently	2 (1.3%)	4 (2.5%)	6 (3.8%)
	Quite regularly	8 (5.1%)	9 (5.7%)	17 (10.8%)
	A few times	17 (10.8%)	17 (10.8%)	34 (21.5%)
	Once or twice	19 (12.0%)	29 (18.4%)	48 (30.4%)
	Never	40 (25.3%)	13 (8.2%)	53 (33.5%)
Frequency of hospital visits	Multiple, as inpatient	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Multiple, day-patient	1 (0.6%)	4 (2.5%)	5 (3.2%)
	Once, as inpatient	5 (3.2%)	2 (1.3%)	7 (4.4%)
	Once, as day-patient	11 (7.0%)	9 (5.7%)	20 (12.7%)
	Never	69 (43.7%)	57 (36.1%)	126 (79.7%)